DEVELOPMENT OF THE HARMONY TARGET SOLAR PV FACILITY NEAR VIRGINIA, FREE STATE PROVINCE

Avifauna Scoping Report

July 2022

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EXECUTIVE SUMMARY

Pachnoda Consulting cc was requested by Savannah Environmental (Pty) Ltd on behalf of Avgold Ltd to compile an avifauna scoping report for the proposed Harmony Target Solar PV facility and associated infrastructure with a contracted capacity of up to 30MW located approximately 1km south of the town of Allanridge, Free State Province.

The objectives of this phase of the project were to obtain a basic overview of the variation and general status of the avifaunal habitat types and expected bird species likely to be affected by the proposed project.

Three broad-scale avifaunal habitat types were identified on the study site and surroundings, ranging from secondary grassland, depressions to transformed and landscape/manicured areas, including cultivated land. The study site was also surrounded by a number of pans and Stinkpan, which provided habitat for a large number of waterbird taxa. A total of 130 bird species have been recorded within the study area, including five Red listed species (threatened and near threatened species).

The main potential impacts associated with the proposed PV solar facility are expected to be the following:

- The loss of habitat and subsequent displacement of bird species due to the ecological footprint required during construction.
- Direct interaction (collision trauma) by birds with the surface infrastructure (photovoltaic panels) caused by polarised light pollution and/or waterbirds colliding with the panels (as they are mistaken for waterbodies).
- Collision with associated infrastructure (mainly overhead powerlines and reticulation).

In addition, a total of 59 collision-prone bird species have been recorded from the study area (*sensu* SABAP2), of which 46 species were waterbird and shorebird taxa and another seven species were birds of prey. These also included the near threatened Greater Flamingo (*Phoenicopterus roseus*) and Lesser Flamingo (Ph*oeniconaias minor*) and the globally endangered Maccoa Duck (*Oxyura maccoa*) which were regular foraging visitors to the nearby Stinkpan.

The study site was located in close proximity to many prominent wetland systems and endorheic pans, and therefore the risk of waterbird colliding with the proposed infrastructure was considered to be high. In addition, a high frequency of waterbirds was expected commuting over the site (or at least part thereof) on a daily basis. Therefore, it is important that the layout of the proposed PV facility, especially the placement of the PV arrays coincides with areas where the frequency of passing waterbirds will be of low frequency in order to minimise potential bird collisions.

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DECLARATION OF INDEPENDENCE

I, Lukas Niemand (Pachnoda Consulting CC) declare that:

- I act as the independent specialist in this application to Savannah Environmental (Pty) Ltd and Avgold Ltd.;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have no vested financial, personal or any other interest in the application;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority; and
- All the particulars furnished by me in this form are true and correct.

Lukas Niemand (Pr.Sci.Nat)
25 July 2022

Lukas Niemand is registered with The South African Council for Natural Scientific Professionals (400095/06) with more than 20 years of experience in ecological-related assessments and more than 15 years in the field of bird interactions with electrical and renewable energy infrastructure. He has conducted numerous ecological and avifaunal impact assessments including Eskom Transmission projects, hydro-electric schemes, solar farms and other activities in South Africa and other African countries.

1. INTRODUCTION

1.1 Project Description

Pachnoda Consulting cc was requested by Savannah Environmental (Pty) Ltd on behalf of Avgold Ltd to compile an avifauna scoping report for the proposed Harmony Target Solar PV facility and associated infrastructure with a contracted capacity of up to 30MW. The Harmony Target Solar PV facility is based approximately 500m south of the Harmony Target mining operations, and approximately 1km south of the town of Allanridge within the Matjhabeng Local Municipality respectively, and within the Lejweleputswa District Municipality, Free State Province.

The solar facility will be located on a 72ha development area, which will include the PV arrays, associated infrastructure and grid connection infrastructure (Figure 2). The infrastructure associated PV facility includes:

- Solar PV arrays comprising of bifacial PV modules and mounting structures, using single axis tracking technology. Once installed, it will stand up to 5m above ground level.
- Inverters and transformers, a SCADA room, and maintenance room.
- Cabling between the project components.
- Balance of Plant:
    - Existing spare switchgear panels, upgraded switchgear circuit breakers or additional switchgear panels.
    - EK self-build works as defined in the CEL.
- On-site facility substation to facilitate the connection between the solar PV facilities and Eskom electricity grid. The Size and Capacity of the on-site stations will be 40MW.
- An onsite Medium voltage (MV) switching station forming part of the collector substation.
- Temporary laydown areas.
- Access roads, internal roads and fencing around the development area.
- Up to 132kV Overhead Power Lines (OHPL) with a maximum of 30m height with a 30m servitude width.
- Underground LV cabling will be used on the PV sites.

The PV facility will be located on the Farm Kromdraai 386.

The facility will tie-in to the Avgold (6.6/44 kV) substation, The grid line will have a connection capacity of up to 132kV. The line connecting the PV facility to the respective substation will be up to 44kV.

To avoid areas of potential sensitivity and to ensure that potential detrimental environmental impacts are minimised as far as possible, the developer will identify a suitable development footprint within which the infrastructure of Harmony One Plant

Solar PV facility and its associated infrastructure is proposed to be located and fully assessed during the EIA Phase.

1.2 Terms of Reference

The main aim of this scoping exercise was to investigate the avifaunal attributes of the proposed PV facility by means of a desktop analysis of GIS based information and third-party datasets and included a brief site visit which constituted the austral winter season sampling survey.

The terms of reference for this scoping report are to:

- conduct an assessment on a screening level based on available information pertinent to the ecological and avifaunal attributes on the study site and immediate surroundings;
- conduct an assessment of all information on a screening level in order to present the following results:
    - typify the regional vegetation and avifaunal macro-habitat parameters that will be affected by the proposed project;
    - provide an indication on the occurrence of threatened, near-threatened, endemic and conservation important bird species likely to be affected by the proposed project;
    - provide an indication of sensitive areas or bird habitat types corresponding to the study site and immediate surroundings;
    - highlight areas of concern or "hotspot" areas;
    - identify potential impacts that are considered pertinent to the proposed development;
    - highlight gaps of information in terms of the avifaunal environment; and
    - recommend further studies to be conducted as part of the Environmental Impact Assessment (EIA) phase.

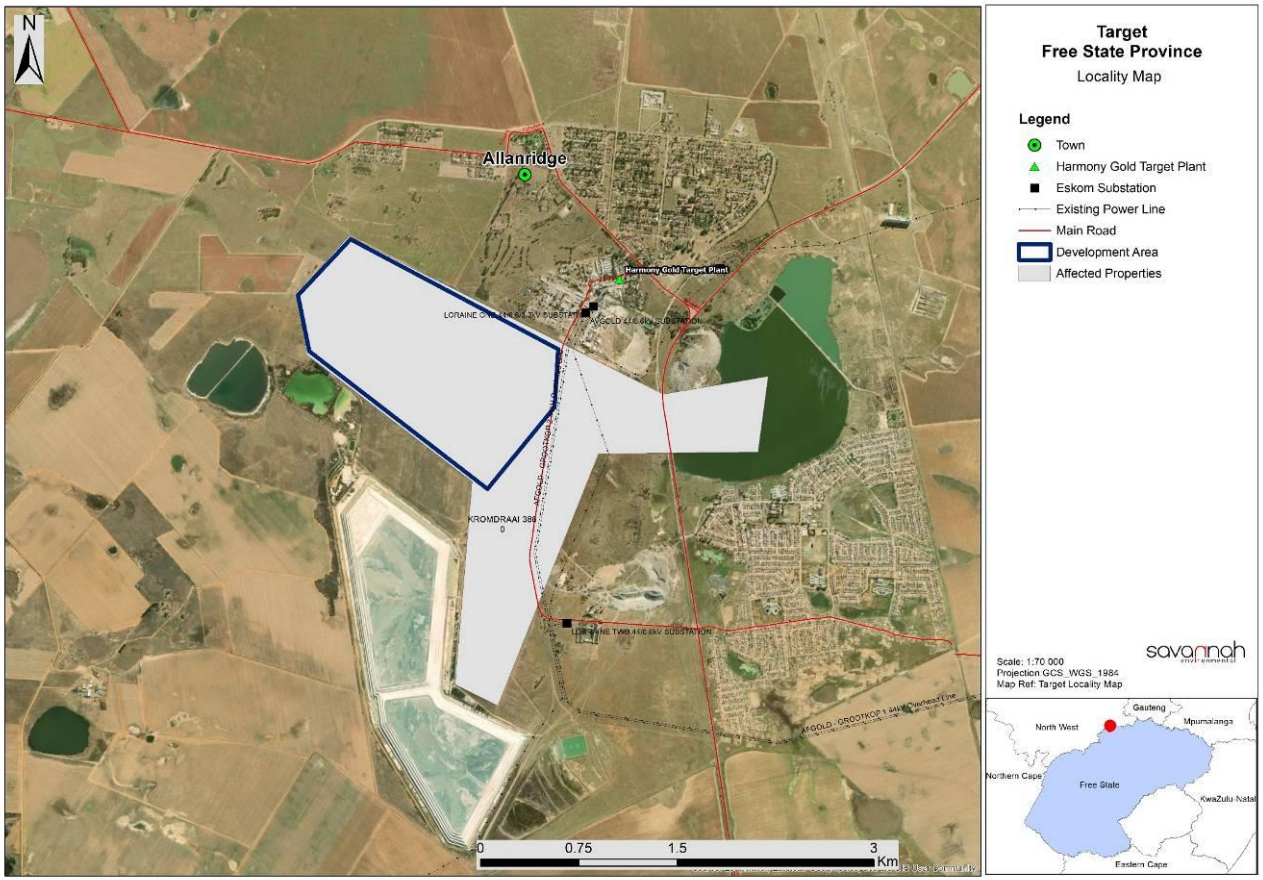

Figure 1: A map illustrating the geographic position of the proposed Harmony Target Solar PV facility.

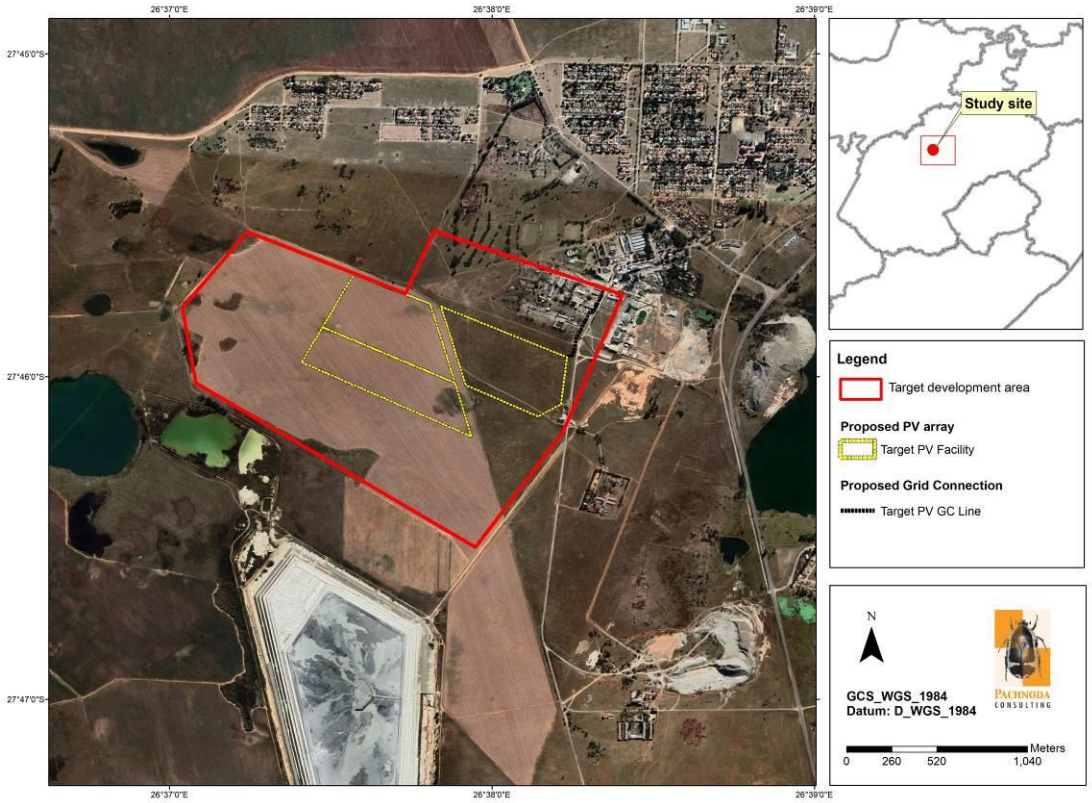

Figure 2: A satellite image illustrating the geographic position of the proposed Harmony Target Solar PV facility and proposed alternatives.

2. METHODS & APPROACH

The objectives of this phase of the project were to obtain a basic overview of the variation and general status of the avifaunal habitat types and expected bird species likely to be affected by the proposed project.

Also take note that the current report put emphasis on the avifaunal community as a key indicator group on the proposed study site and immediate surroundings, thereby aiming to describe the preliminary conservation significance of the ecosystems in the area. Therefore, the occurrence of certain bird species and their relative abundances (to be determined during the EIA although herewith deduced from reporting rates) could determine the outcome of the ecological sensitivity of the area and the subsequent layout of the proposed solar facility infrastructure.

The information provided in this report was principally sourced from the following sources/observations:

- relevant literature – see section below;
- observations made during a site visit (06 - 09 June 2022); and
- personal observations from similar habitat types in close proximity to the study area.

2.1 Literature survey and Database acquisition

A desktop and literature review of the area under investigation was commissioned to collate as much information as possible prior to the detailed baseline survey. Literature consulted primarily makes use of small-scale datasets that were collected by citizen scientists and are located at various governmental and academic institutions (e.g. Animal Demography Unit & SANBI). These include (although are not limited to) the following:

- Hockey *et al*. (2005) for general information on bird identification and life history attributes.
- Marnewick *et al.* (2015) was consulted for information regarding the biogeographic affinities of selected bird species that could be present on the study area.
- The conservation status of bird species was categorised according to the global IUCN Red List of threatened species (IUCN, 2022) and the regional conservation assessment of Taylor *et al.* (2015).
- Distributional data was sourced from the South African Bird Atlas Project (SABAP1) and verified against Harrison et al. (1997) for species corresponding to quarter-degree grid cells (QDGCs) 2726DA (Skoonspruit) and 2726DC (Odendaalsrus) (Figure 3). The information was then modified according to the prevalent habitat types present on the study area. The SABAP1 data provides a “snapshot” of the abundance and composition of species recorded within a quarter degree grid cell (QDGC) which was the

sampling unit chosen (corresponding to an area of approximately 15 min latitude x 15 min longitude). It should be noted that the atlas data makes use of reporting rates that were calculated from observer cards submitted by the public as well as citizen scientists. It therefore provides an indication of the thoroughness of which the QDGCs were surveyed between 1987 and 1991;

- Additional distributional data was also sourced from the SABAP2 database (http://www.sabap2.birdmap.africa). The information was then modified according to the prevalent habitat types present on the study area. Since bird distributions are dynamic (based on landscape changes such as fragmentation and climate change), SABAP2 was born (and launched in 2007) from SABAP1 with the main difference being that all sampling is done at a finer scale known as pentad grids (5 min latitude x 5 min longitude, equating to 9 pentads within a QDGC). Therefore, the data is more site-specific, recent and more comparable with observations made during the site visit (due to increased standardisation of data collection). The pentad grid relevant to the current project is 2745_2635 (although all eight pentad grids surrounding grid 2745_2635 were also scrutinised; Figure 4).
- The choice of scientific nomenclature, taxonomy and common names were recommended by the International Ornithological Committee (the IOC World Bird List v. 12.1), unless otherwise specified (see www.worldbirdnames.org as specified by Gill et al, 2022). Colloquial (common) names were used according to Hockey *et. al.* (2005) to avoid confusion;
- The best practice guidelines for assessing and monitoring the impact of solar power generating facilities on birds in southern Africa were also consulted (Jenkins *et al.,* 2017).
- Additional information regarding bird-power line interactions was provided by the author's own personal observations.

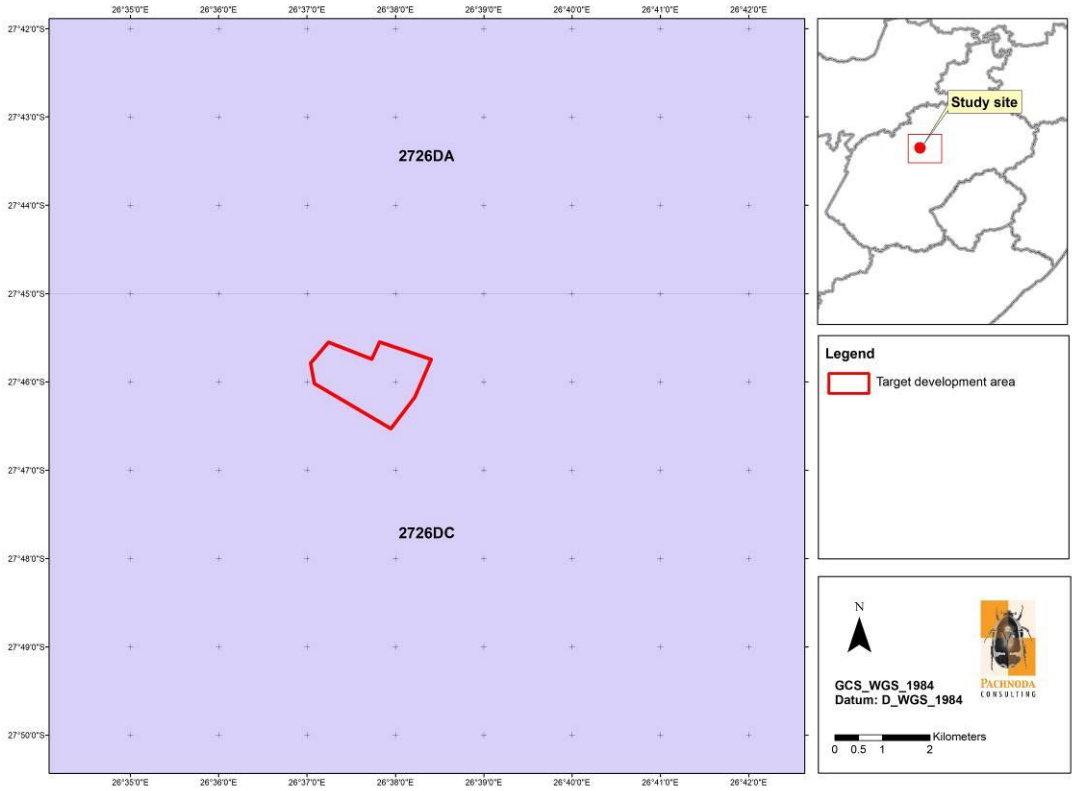

Figure 3: A map illustrating the quarter-degree grid cells that were investigated for this project.

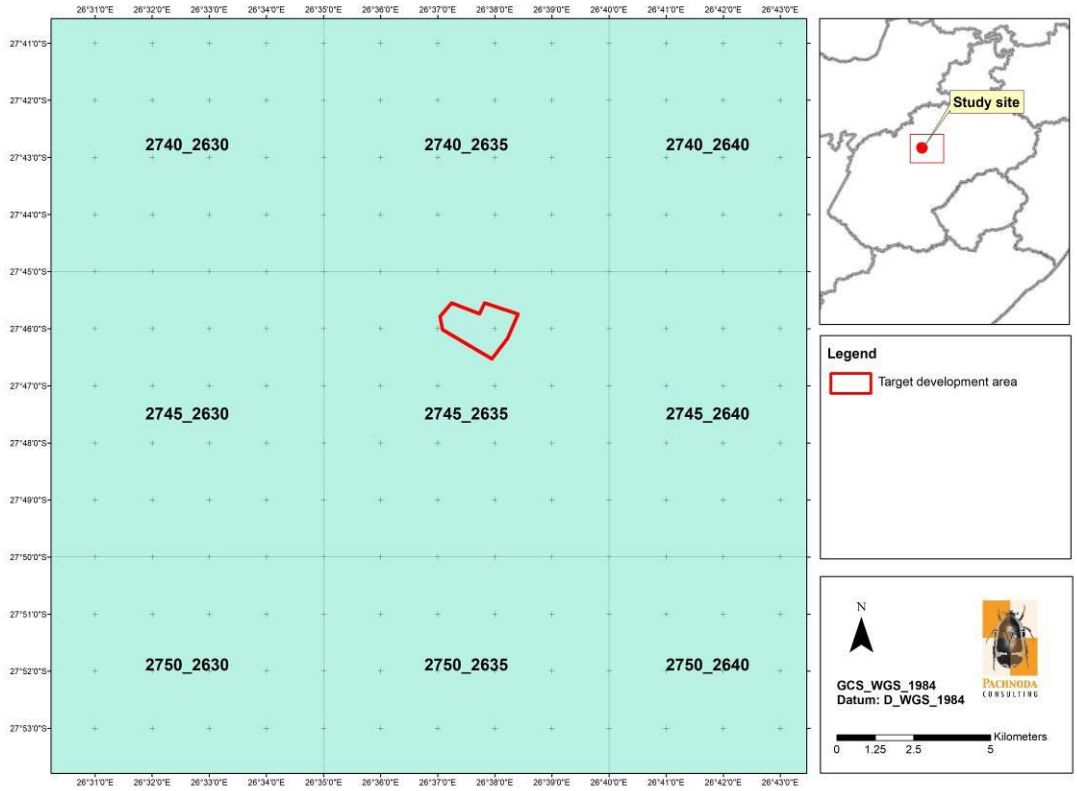

Figure 4: A map illustrating the pentad grids that were investigated for this project.

2.2 Preliminary Sensitivity Analysis

A preliminary sensitivity map was compiled based on the outcome of a desktop analysis.

The ecological sensitivity of any piece of land is based on its inherent ecosystem service (e.g. wetlands) and overall preservation of biodiversity.

2.3.1 Ecological Function

Ecological function relates to the degree of ecological connectivity between systems within a landscape matrix. Therefore, systems with a high degree of landscape connectivity amongst one another are perceived to be more sensitive and will be those contributing to ecosystem service (e.g. wetlands) or the overall preservation of biodiversity.

2.3.2 Avifaunal Importance

Avifaunal importance relates to species diversity, endemism (unique species or unique processes) and the high occurrence of threatened and protected species or ecosystems protected by legislation.

2.3.3 Sensitivity Scale

- *High* – Sensitive ecosystems with either low inherent resistance or low resilience towards disturbance factors or highly dynamic systems considered important for the maintenance of ecosystem integrity. Most of these systems represent ecosystems with high connectivity with other important ecological systems OR with high species diversity and usually provide suitable habitat for a number of threatened or rare species. These areas should preferably be protected;
- *Medium* – These are slightly modified systems which occur along gradients of disturbances of low-medium intensity with some degree of connectivity with other ecological systems OR ecosystems with intermediate levels of species diversity but may include potential ephemeral habitat for threatened species; and
- *Low* – Degraded and highly disturbed/transformed systems with little ecological function and are generally very poor in species diversity (most species are usually exotic or weeds).

2.3 Limitations

To obtain a comprehensive understanding of the diversity and dynamics of avifaunal community on the study area, as well as the status of endemic, rare or threatened species in the area, detailed assessments should always consider investigations at different time scales (across seasons/years) and through replication. However, due to the fact that the findings in this report were based on a scoping/screening assessment, long-term studies were not feasible and inferred interpretations were mostly based on ad hoc observations.

It should also be realised that bird distribution patterns fluctuate widely in response to environmental conditions (e.g. local rainfall patterns, nomadism, migration patterns, seasonality), meaning that a composition noted at a particular moment in time will differ during another time period at the same locality. For this reason two surveys will be conducted during the data collection.

Due to the scope of the work presented during a scoping assessment, a detailed investigation of the avifaunal community in the area were not possible and is not perceived as part of the Terms of Reference for a scoping/screening level exercise.

Furthermore, additional information may become known during a later stage of the process or development. This company, the consultants and/or specialist investigators do not accept any responsibility for conclusions, suggestions, limitations and recommendations made in good faith, based on the information presented to them, obtained from the surveys or requests made to them at the time of this report.

The following assumptions are relevant to the literature survey and database acquisition phase:

- It is assumed that third party information (obtained from government, academic/research institution, non-governmental organisations) is accurate and true;
- Some of the datasets are out of date and therefore extant distribution ranges may have shifted although these datasets could provide insight into historical distribution ranges of relevant species;
- The datasets are mainly small-scale and could not always consider azonal habitat types that may be present on the study area (e.g. small dams, pans and depressions). In addition, these datasets encompass surface areas larger than the study area that could include habitat types and species that is not present on the study area. Therefore, the potential to overestimate species richness is highly likely while it is also possible that certain cryptic or specialist species could have been overlooked in the past;
- Some of the datasets (e.g. SABAP2) managed by the Animal Demography Unit of the University of Cape Town were only recently initiated and therefore incomplete; and

3. PRELIMINARY RESULTS AND DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1 Locality

The proposed PV facility will be located approximately 500m south of the Harmony Target mining operations, and 1km south of the town of Allanridge, Free State Province (Figure 1).

3.2 Regional Vegetation Description

The proposed PV facility corresponds to the Grassland Biome and more particularly to the Dry Highveld Grassland Bioregion as defined by Mucina & Rutherford (2006). It comprehends an ecological type known as Vaal-Vet Sandy Grassland (Mucina & Rutherford, 2006) (Figure 5).

From an avifaunal perspective it is evident that bird diversity is positively correlated with vegetation structure, and floristic richness is not often regarded to be a significant contributor of patterns in bird abundance and their spatial distributions. Although grasslands are generally poor in woody plant species, and subsequently support lower bird richness values, it is often considered as an important habitat for many terrestrial bird species such as larks, pipits, korhaans, cisticolas, widowbirds including large terrestrial birds such as Secretarybirds, cranes and storks. Many of these species are also endemic to South Africa and display particularly narrow distribution ranges. Due to the restricted spatial occurrence of the Grassland Biome and severe habitat transformation, many of the bird species that are restricted to the grasslands are also threatened or experiencing declining population sizes.

The Vaal-Vet Sandy Grassland occurs in the Free State and North-West Provinces, where it extends from Lichtenburg and Ventersdorp southwards to Klerksdorp, Leeudoringstad, Bothaville and the Brandfort area north of Bloemfontein. It occurs at an altitude of 1 220-1 560 m and is mainly confined to aeolian and colluvial sand overlying shales and mudstones. The floristic structure of the Vaal-Vet Sandy Grassland is mainly a low tussocky grassland with many karroid elements. In its untransformed condition, *Themeda triandra* is an important dominant graminoid, while intense grazing and erratic rainfall is responsible for an increase of *Elionurus muticus, Cymbopogon pospischilii* and *Aristida congesta*.

The Vaal-Vet Sandy Grassland is a threatened (**Endangered**) ecosystem with only a few remaining patches of untransformed grassland being statutorily conserved (c. 0.3 % at Bloemhof Dam, Schoonspruit, Sandveld, Faan Meintjies, Wolwespruit and Soetdoring Nature Reserves). In addition, the Vaal-Vet Sandy Grassland is a Critically Endangered Ecosystem (as per Section 52 of National Environmental Management Biodiversity Act, (Act No. 10 of 2004)) and a Critical Biodiversity Area

as per the Free State Conservation Plan (DESTEA, 2015). More than 63 % of this grassland type is already transformed by cultivation, and intense livestock grazing.

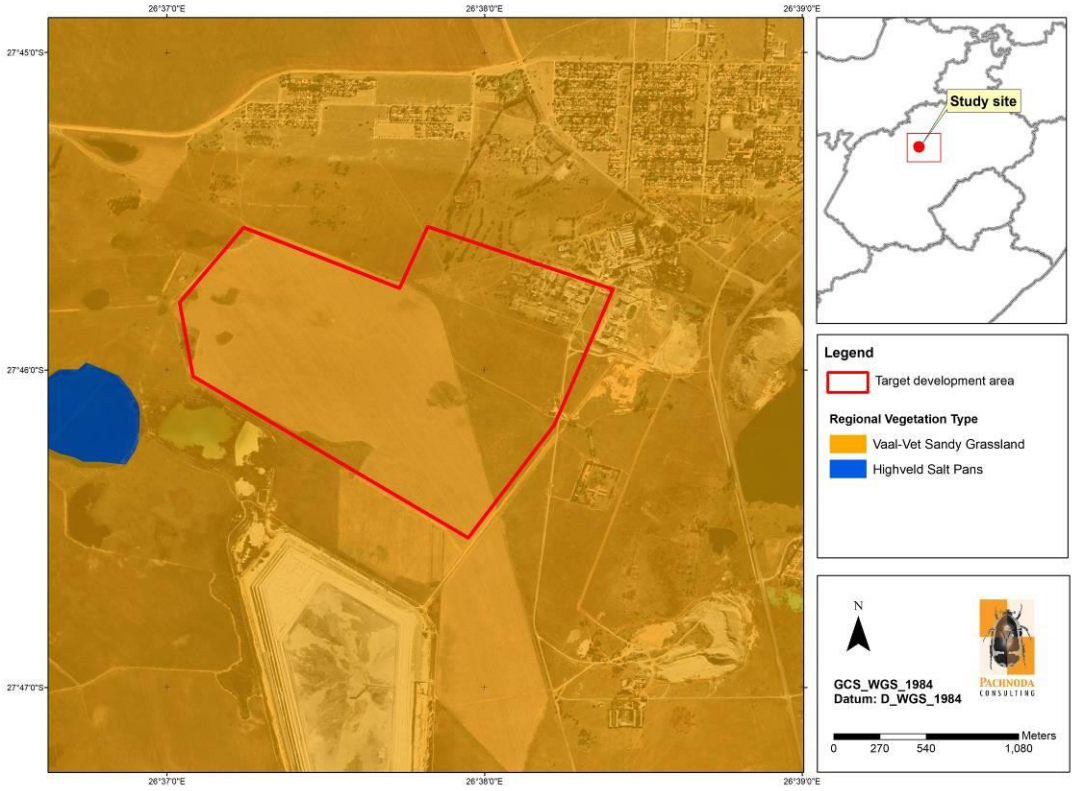

Figure 5: A satellite image illustrating the regional vegetation type corresponding to the study site and immediate surroundings. Vegetation type categories were defined by Mucina & Rutherford (2006; updated 2012).

3.3 Land cover, land use and existing infrastructure.

According to the South African National dataset of 2013-2014 (Geoterrainimage, 2015) the study site comprehends the following land cover categories (Figure 7):

Natural areas:

- Grassland;
- Low shrubland;
- small patches of thicket and dense bush; and
- also small surface areas pertaining to wetland habitat.

Transformed areas:

- Mining infrastructure;
- Build-up areas; and
- Cultivation.

From the land cover dataset it is evident that most of the study site is covered by cultivated land and historically ploughed land which consists currently of secondary grassland. However, the north-eastern part of the study area is mainly transformed and consists of mining infrastructure (e.g. the Harmony Target plant) and build-up land which contain manicured parks. A number of small depressions are scattered across the site (most of them contained within cultivated land) which was not digitised by the Geoterrainimage (2015) dataset and should be included as seasonal wetlands. However, some of these are colonised by moist grassland. The study site is also surrounded by numerous endorheic pans, as well as pollution control dams and the large Stinkpan (east of the study site). These pan basins, when inundated provides foraging, roosting and breeding habitat for large congregations of waterbird and shorebird species, including species that are globally and regionally threatened and near threatened.

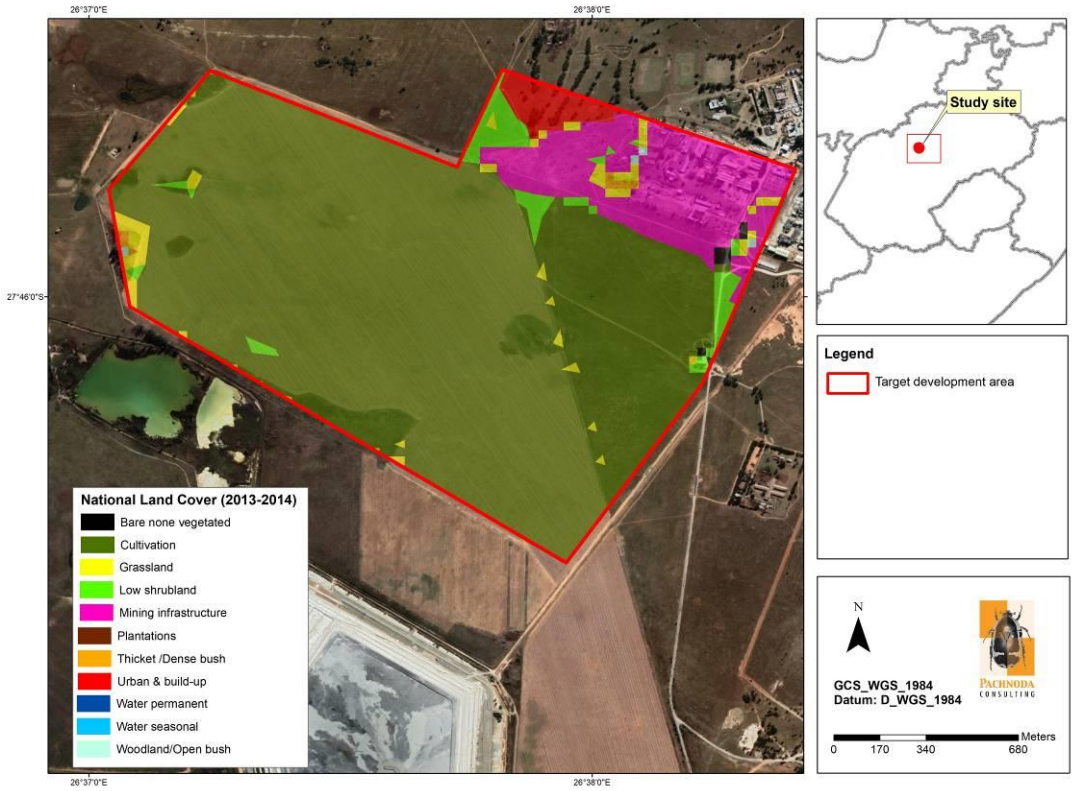

Figure 6: A map illustrating the land cover classes (Geoterrainimage, 2015) corresponding to the proposed study site and immediate surroundings.

3.4 Conservation Areas, Protected Areas and Important Bird Areas

The study site does not coincide with any formal conservation area or Important Bird and Biodiversity Area (IBA). The nearest legal conservation area to the proposed study site is the Sandveld and Bloemhof Dam Nature Reserves, which is located 45

km north-west of the study site. The Sandveld and Bloemhof Dam Nature Reserves are also a recognised IBA (SA039).

3.5 Annotations on the National Web-Based Environmental Screening Tool

Regulation 16(1)(v) of the Environmental Impact Assessment Regulations, 20145 (EIA Regulations) provides that an applicant for Environmental Authorisation is required to submit a report generated by the Screening Tool as part of its application. On 5 July 2019, the Minister of Environmental Affairs, Forestry and Fisheries published a notice in the Government Gazette giving notice that the use of the Screening Tool is compulsory for all applicants to submit a report generated by the Screening Tool from 90 days of the date of publication of that notice.

The Screening Tool is intended to allow for pre-screening of sensitivities in the landscape to be assessed within the EA process. This assists with implementing the mitigation hierarchy by allowing developers to adjust their proposed development footprint to avoid sensitive areas. The Screening Tool report will indicate the (preliminary) environmental sensitivities that intersect with the proposed development footprint as defined by the applicant as well as the relevant Protocols.

As the Screening Tool contains datasets that are mapped at a national scale, there may be areas where the Screening Tool erroneously assigns, or misses, environmental sensitivities because of mapping resolution and a high paucity of available and accurate data. Broad-scale site investigations will provide for an augmented and site-specific evaluation of the accuracy and ‘infilling’ of obvious and large-scale inaccuracies. Information extracted from the National Web-based Environmental Screening Tool (Department of Environmental Affairs, 2020), indicated that the study site and immediate surroundings hold a **medium** sensitivity with respect to the relative animal species protocol (Figure 7) (report generated 05/08/2022):

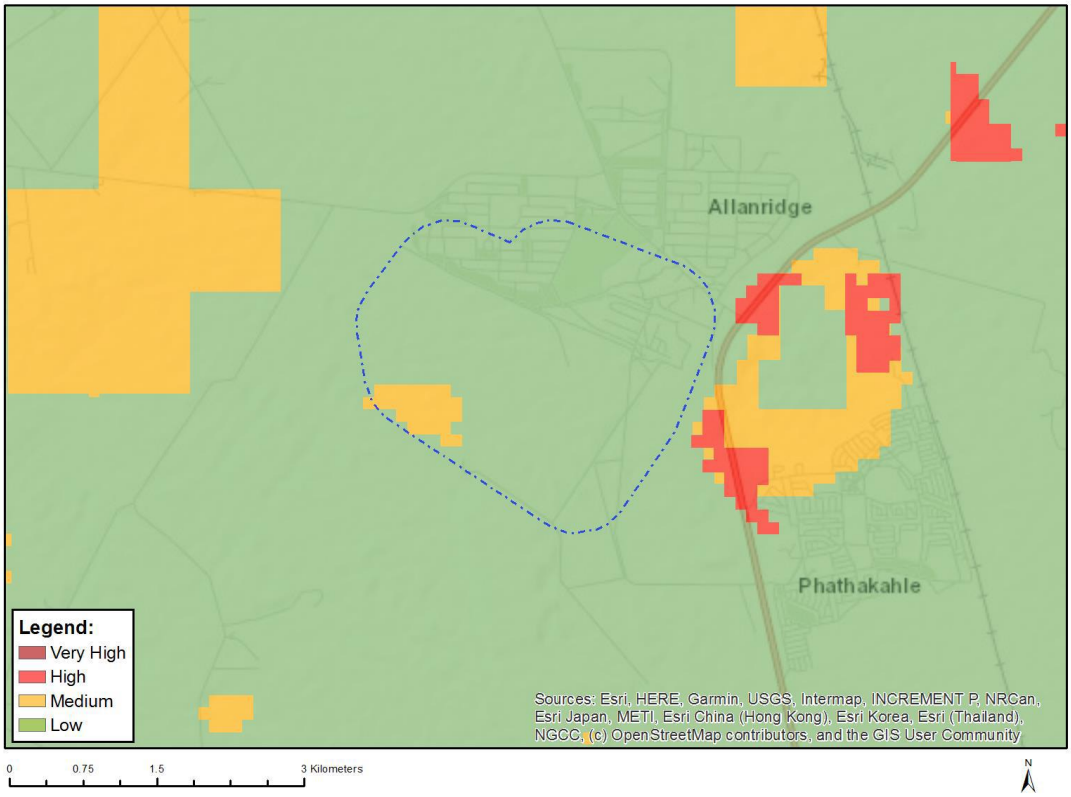

Figure 7: The animal species sensitivity of the study site and immediate surroundings (a 500m buffer was added to the site boundary) according to the Screening Tool.

Sensitive features include the following:

Sensitivity	Feature(s)
Low	Subject to confirmation
Medium	Aves-*Hydroprogne caspia*

According to the results of the screening tool, a medium probability of occurrence is evident for the vulnerable Caspian Tern (*Hydroprogne caspia*), which could potentially occur at the pan and pollution control dams located at the south-western part of the study site. In addition, the nearby Stinkpan has a high probability of the occurrence of the endangered African Marsh Harrier (*Circus ranivorus*) and Yellow-billed Stork (*Mycteria ibis*). The probability for these species to occur on the study site will be assessed during a detailed baseline (EIA) survey.

It is evident that the study site and immediate surroundings correspond to a **low** avian theme sensitivity (see Figure 8).

Figure 8: The relative avian sensitivity of the study site and immediate surroundings (a 500m buffer was added to the site boundary) according to the Screening Tool.

Sensitive features include the following:

Sensitivity	Feature(s)
Low	Low sensitivity

However, the study site and immediate surroundings hold a **very high** sensitivity with respect to the relative terrestrial biodiversity theme (Figure 9):

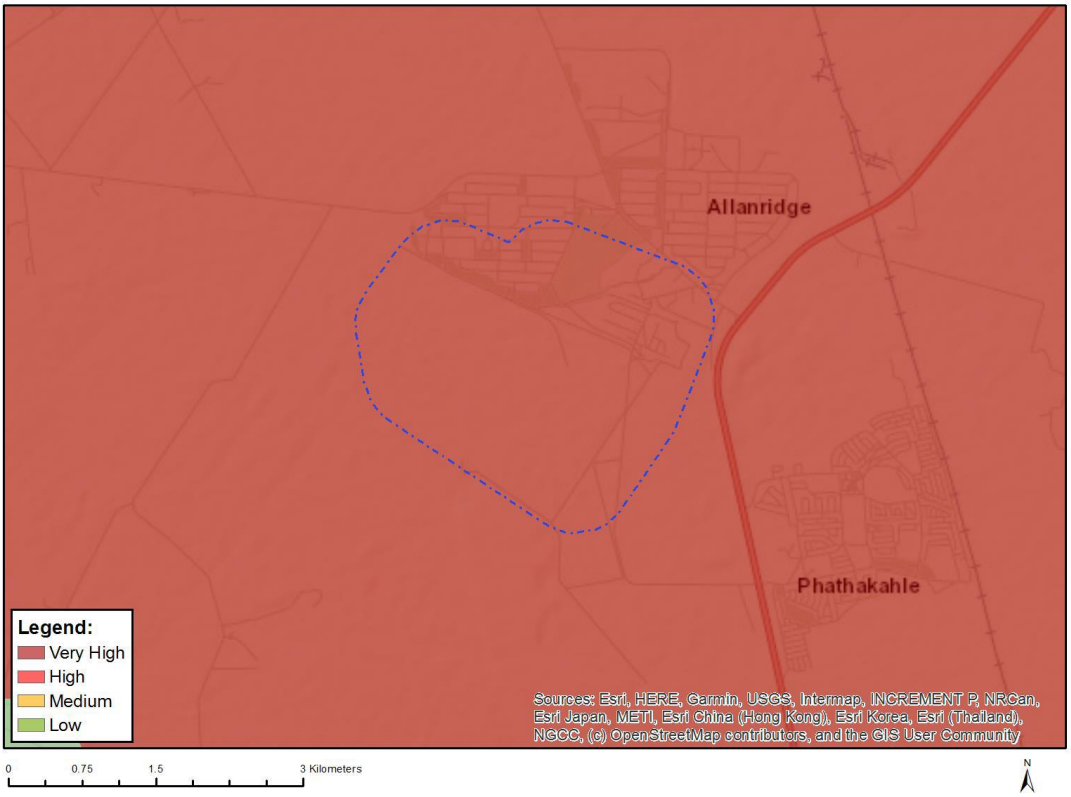

Figure 9: The relative terrestrial biodiversity sensitivity of the study site and immediate surroundings (a 500m buffer was added to the site boundary) according to the Screening Tool.

Sensitive features include the following:

Sensitivity	Feature(s)
Very High	Critical Biodiversity Area 1
Very High	Ecological Support Area 1
Very High	Ecological Support Area 2
Very High	Endangered Ecosystem

It is evident from the results of the Screening Tool report the entire study area coincides with a Critical Biodiversity Area 1 (CBA 1) and Ecological Support Area 1 and 2 (ESA 1 & 2) as per the Free State Biodiversity Plan (DESTEA, 2015). In addition, the study site also coincides with an Endangered ecosystem which is represented by the Vaal-Vet Sandy Grassland.

3.6 Preliminary avifaunal habitat types

Apart from the regional vegetation type, the local composition and distribution of the vegetation associations on the study site and immediate surroundings are a consequence of a combination of factors simulated by geomorphology, presence of wetland features and past land use practice which have culminated in a number of habitat types that deserve further discussion[1] (Figure 10):

[1] The habitat types are subject to change pending on the outcome of a detailed baseline surveys.

1. *Secondary grassland:* This unit is prominent on the eastern part of the study site of which most were historically under cultivation in the past. It represents a grassland sere with a secondary graminoid composition that is dominated by *Cynodon dactylon* and graminoid species of the genus *Eragrostis*. The expected bird composition is represented by widespread cryptic grassland species. Typical bird species expected to be present include Desert Cisticola (*Cisticola aridulus*), Red-capped Lark (*Calandrella cinerea*), Ant-eating Chat (*Myrmecocichla formicivora*) and Double-banded Courser (*Rhinoptilus africanus*). It also provides foraging and breeding habitat for the collision-prone species, the Northern Black Korhaan (*Afrotis afraoides*).

2. *Pans, depressions, pollution control dams and Stinkpan*: These habitat features include a number of mainly endorheic pan basins which becomes seasonally inundated during the austral wet season. They provide foraging, roosting and also breeding habitat for a diversity of waterbird species, of which the richness is proportional to the surface area and depth of the pans. Thereby, large, shallow pans are more likely to sustain larger congregations of waterbird numbers and waterbird species. Most of these pans occur along the periphery of the study site, but are regarded as an "inter-connected" system of pans, meaning that none of the pans within the local catchment are similar to each, thereby providing a continuous supply of resources for waterbirds which tend to commute on a daily basis over the study site. Furthermore, the large and nearby Stinkpan also provides important foraging habitat for two near threatened flamingo species as well as the globally engendered Maccoa Duck (*Oxyura maccoa*) (pers. obs.).

   Most of the basins of depressions on the study site is colonised by moist grassland, and these are more likely to provide habitat for a unique bird composition represented by smaller wetland-associated passerine species, such as Zitting Cisticola (*C. juncidis*), Levaillant's Cisticola (*C. tinniens*) and Quailfinch (*Ortygospiza atricollis*).

   A series of pollution control dams are located near the south-western boundary of the study site and these also provide ephemeral habitat for a variety of waterbird species, most notably Cape Teal (*Anas capensis*), Black-winged Stilt (*Himantopus himantopus*), Cape Shoveller (*A. smithii*), Red-billed Teal (*A. erythrorhyncha*) and Black-necked Grebe (*Podiceps nigricollis*).

3. *Transformed, landscaped (manicured) areas and cultivation*: These areas are represented by build-up land and landscaped areas as well as areas under active commercial cultivation. The manicured park are earmarked by a distinct tree dominated by *Searsia lancea* which was artificially planted. These "parks" area colonised by a high number of bird species which favour the vertical heterogeneity provided by the tree canopy. The bird composition is expected to be represented by a "bushveld" composition which is often present in semi-

urban landscaped (manicured) gardens and parks (c. Ring-necked Dove *Streptopelia capicola*, Rattling Cisticola *Cisticola cheniana*, Red-eyed Dove *S. semitorquata*, Cape Starling *Lamprotornis nitens*), Chestnut-vented Warbler *Curruca subcaerulea*, Blue Waxbill *Uraeginthus angolensis* and Green Wood-hoopoe (*Phoeniculus purpureus*).

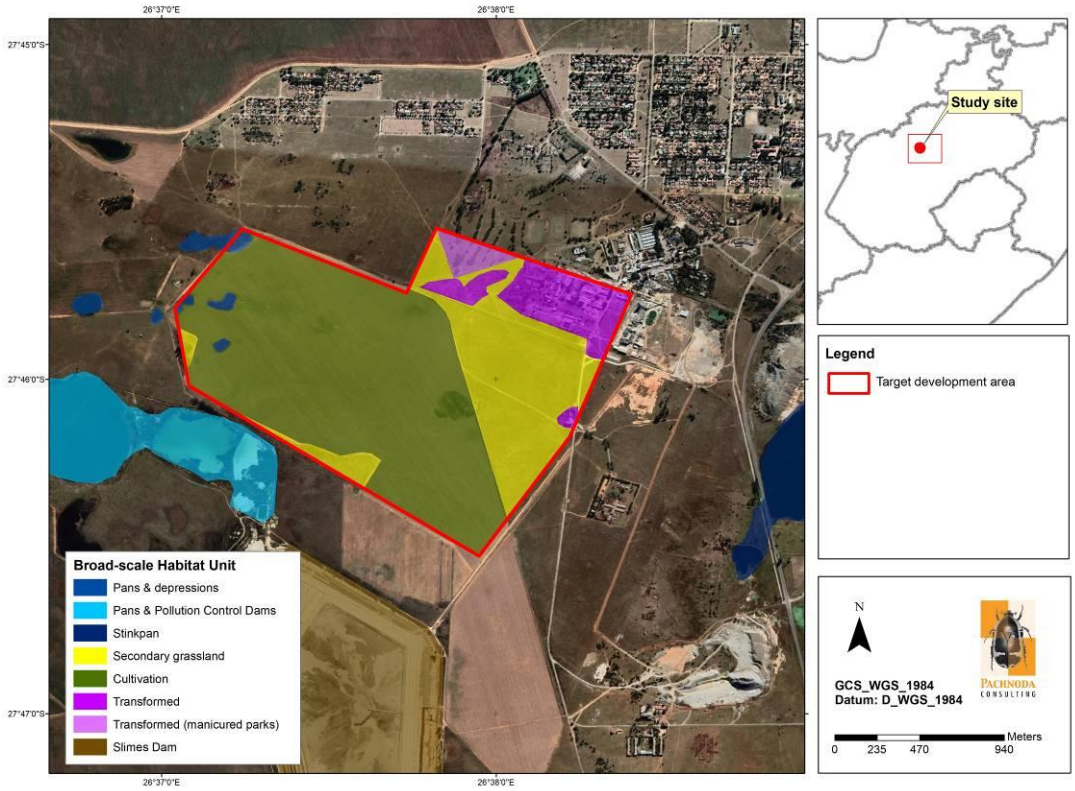

Figure 10: A preliminary habitat map illustrating the avifaunal habitat types on the study site and immediate surroundings (the habitat types are subject to change pending the outcome of a detailed baseline surveys).

3.7 Species Richness and Predicted summary statistics

Approximately ~130 bird species have been recorded within the study area (refer to Appendix 1 & Table 1), although it is more likely that between 50-70 bird species could occur within the physical boundaries of the study site (according to the habitat types and the ecological condition thereof). The richness was inferred from the South African Bird Atlas Project (SABAP2)[2] (Harrison et al., 1997; www.sabap2.birdmap.africa) and the presence of suitable habitat in the study area. This equates to 13 % of the approximate 987[3] species listed for the southern African

[2] The expected richness statistic was derived from pentad grid 2745_2635 totalling 129 bird species (based on seven full protocol cards).

3 *sensu* www.zestforbirds.co.za (Hardaker, 2020), including four recently confirmed bird species (vagrants.

subregion[4] (and approximately 15 % of the 871 species recorded within South Africa[5]). However, an average number of 48 species for each full protocol card submitted, were recorded for the pentad grid 2745_2635 corresponding to the study site (for observations of two hours or more; range= 1 - 78 species). It provides a more realistic species tally of the bird composition on the physical study site.

According to Table 1, biome-restricted[6] remained to be absent on the study area and the local endemic and near-endemic bird richness were extremely low. It also a low diversity of regional endemics, with 9 % of the endemic species present in the subregion. In addition, a large percentage of the species recorded in the study area is represented by waterbirds and shorebird taxa (ca. 38% of the total number of recorded bird species, sensu SABAP2).

Table 1: A summary table of the total number of species, Red listed species (according to Taylor et al., 2015 and the IUCN, 2022), endemics and biome-restricted species (Marnewick et al., 2015) expected (*sensu* SABAP2) to occur in the study site and immediate surroundings.

Description	Expected Richness Value
Total number of species*	130 (15 %)
Number of Red Listed species*	5 (3.6 %)
Number of biome-restricted species – Zambezian and Kalahari-Highveld Biomes)*	0 (0 %)
Number of local endemics (BirdLife SA, 2022)*	1 (3 %)
Number of local near-endemics (BirdLife SA, 2022)*	3 (10 %)
Number of regional endemics (Hockey *et al.,* 2005)**	9 (9 %)
Number of regional near-endemics (Hockey *et al.,* 2005)**	7 (11 %)

* only species in the geographic boundaries of South Africa (including Lesotho and eSwatini) were considered.

** only species in the geographic boundaries of southern Africa (including Namibia, Botswana, Zimbabwe and Mozambique south of the Zambezi River) were considered

*** Percentage values in brackets refer to totals compared against the South African avifauna (*sensu* BirdLife SA, 2022).

3.8 Bird species of conservation concern

Table 2 provides an overview of bird species of conservation concern that could occur on the study site and immediate surroundings based on their historical distribution ranges and the presence of suitable habitat. According to Table 2, a total of five species could occur on the study area which includes one globally threatened species, one globally near threatened species, two regionally threatened species and one regionally near-threatened species.

It is evident from Table 2 that the highest reporting rates (>50%) were observed for the globally near threatened Lesser Flamingo (*Phoeniconaias minor*) and regionally

4 A geographical area south of the Cunene and Zambezi Rivers (includes Namibia, Botswana, Zimbabwe, southern Mozambique, South Africa, eSwatini and Lesotho).

5 With reference to South Africa (including Lesotho and eSwatini (BirdLife South Africa, 2022).

6 A species with a breeding distribution confined to one biome. Many biome-restricted species are also endemic to southern Africa.

near threatened Greater Flamingo (*Phoenicopterus roseus*). These two species are regarded as regular foraging visitors to the nearby pans (including the pollution control dams) and Stinkpan which is located adjacent to the study site. However, these species are probably absent on the physical study site due to the absence of any suitable habitat on the study site. *Nevertheless, birds dispersing or commuting between the nearby pans and Stinkpan, will have to fly over the study site and could potentially interact (collide) with the PV panels and associated electrical infrastructure*. In addition, *the close proximity of these water features to the study site will also increase the risk of these species interacting with the PV infrastructure.*

The remaining species have low reporting rates (<20%) and are regarded as irregular foraging visitors to the study site with the exception of the globally endangered Maccoa Duck (*Oxyura maccoa*). The latter species was probably overlooked in the past and is regarded as regular foraging visitors (and probably also breeding visitors) to the nearby Stinkpan.

Table 2: Bird species of conservation concern that could utilise the study site based on their historical distribution range and the presence of suitable habitat. Red list categories according to the IUCN (2022)* and Taylor et al. (2015)**.

Species	Global Conservation Status*	National Conservation Status**	SABAP2 reporting rate	Preferred Habitat	Potential Likelihood of Occurrence
Circus ranivorus (African Marsh Harrier)	-	Endangered	16.67	Restricted to permanent wetlands with extensive reedbeds.	Probably absent from the study site, although it could occur along the well-vegetated margins of the nearby Stinkpan. Only known from a single observation during 2011 in the study region. (sensu SABAP2).
Oxyura maccoa (Maccoa Duck)	Endangered	Vulnerable	16.67	Large saline pans and shallow impoundments.	A regular foraging visitor and possibly also breeding visitor to the pans and impounds adjacent to the study site. It was observed on Stinkpan (July 2022; pers. obs.). Probably absent

Species	Global Conservation Status*	National Conservation Status**	SABAP2 reporting rate	Preferred Habitat	Potential Likelihood of Occurrence
					on the physical study site due to the absence of suitable habitat. Birds dispersing between pans could potentially fly over the site and may interact with the PV panels en electrical infrastructure.
Mycteria ibis (Yellow-billed Stork)	-	Endangered	16.67	Wetlands, pans and flooded grassland.	Probably an irregular foraging visitor to the pans in the region. Iit is currently only known from a single recent record obtained during 03 March 2022 (sensu SABAP2). Probably absent on the physical study site due to the absence of suitable habitat. Birds dispersing between pans could potentially fly over the site and may interact with the PV panels en electrical infrastructure.
Phoeniconaias minor (Lesser Flamingo)	Near-threatened	Near-threatened	66.67	Restricted to large saline pans and other inland water bodies containing cyanobacteria.	A regular foraging visitor to the shallow margins of Stinkpan (pers. obs.) and probably also the nearby smaller pans. Probably absent on the physical study site due to the absence of suitable habitat. Birds dispersing between the pans and dams in the area

Species	Global Conservation Status*	National Conservation Status**	SABAP2 reporting rate	Preferred Habitat	Potential Likelihood of Occurrence
					could potentially fly over the site and may interact with the PV panels en electrical infrastructure.
Phoenicopterus roseus (Greater Flamingo)	-	Near-threatened	83.33	Restricted to large saline pans and other inland water bodies.	A highly regular foraging visitor to the shallow margins of Stinkpan (pers. obs.) and probably also the nearby smaller pans. Probably absent on the physical study site due to the absence of suitable habitat. Birds dispersing between the pans and dams in the area could potentially fly over the site and may interact with the PV panels en electrical infrastructure.

3.9 Preliminary avifaunal sensitivity

A preliminary sensitivity map was compiled, illustrating habitat units comprising of potential sensitive elements based on the following arguments (Figure 11):

Areas of high sensitivity

It includes the depressions, pollution control dams, and all the adjacent pans and buffer zones.

The depressions on site have the potential to attract passerine bird species with high affinities for wetland-associated habitat units. It thereby contribute towards the local avian richness in supporting bird species that are otherwise absent from the surrounding terrestrial "dryland" grassland units.

Nevertheless, all the nearby pans, including Stinkpan and some of the pollution control dams support congregations of waterfowl and shorebirds taxa. These include globally and regionally threatened and near threatened species (e.g. flamingo taxa and Maccoa Duck). The pans are also important from a functional and dynamic perspective at the landscape level since they are part of an "inter-connected" system of "stepping stones" within the local catchment, meaning that environmental conditions at these pans (e.g. water levels, salinity, food availability, availability of shoreline habitat) are constantly changing. Therefore, none of the pans within catchment are similar to each, thereby providing a continuous supply of resources for waterbirds which tend to commute on a daily basis over the study site and along the edges of the slimes dams (which are often inundated). The placement of electrical infrastructure and PV panels in close proximity to these areas, as well as on areas where the frequency of fly-overs by waterbirds are high could elevate potential avian collisions with the infrastructure. Nevertheless, the pollution control dams are of artificial origin, and could be removed or relocated.

Areas of low sensitivity

These habitat units are represented by transformed types and include the secondary grasslands, cultivated land, build-up areas and landscaped/manicured areas.

The preliminary sensitivity map shows a large surface area that is earmarked with low sensitivity. There is a probability that some of these units or part thereof could have higher (or lower) sensitivity ratings. It is therefore expected that some of the units or part thereof could represent different sensitivity ratings to those displayed in Figure 11 pending the outcome of a detailed baseline survey.

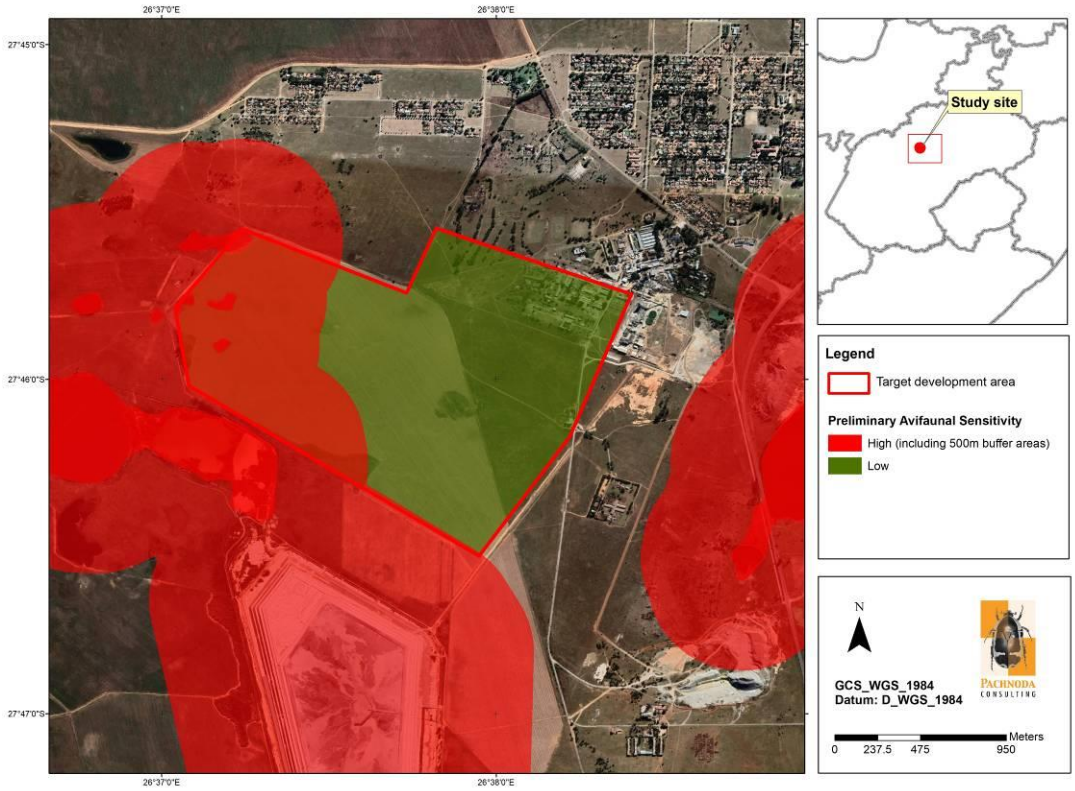

Figure 11: A map illustrating the preliminary avifaunal sensitivity of the area based on habitat types supporting bird taxa of conservation concern and important ecological function.

3.10 Overview of Avian Impacts at Solar Facilities

3.10.1 Background to solar facilities and their impact on birds

Birds are mobile, and are therefore also more readily affected by solar facilities than other taxonomic groups (e.g. mobile mammals that could move away from the facilities due to displacement). In fact, birds are also vulnerable to impacts caused by other types of energy facilities such as overhead power lines and wind farms. Little information is available on the impacts of solar energy facilities on birds although Gunerhan *et al.* (2009), McCrary *et al.* (1986), Tsoutsos *et al.* (2005) and the recent investigation reports on bird fatalities in the USA by Kagen *et al*. (2014) and Walston *et al*. (2016) provide discussions thereof. These studies have shown that avian fatalities vary greatly between the geographic positions of the solar facilities and also depend on the type of solar facility. In addition, very few of the large solar facilities in operation undertake systematic monitoring of avian fatalities, which explains the lack of detailed information of avian impacts. According to these studies conducted at both Concentrated Solar Power (CSP) and PV facilities, avian incidental fatalities range from 14 to over 180 birds which were summarised over a survey period conducted during one to three years. According to the Walston *et al.* (2016) assessment, the average annual mortality rate for known utility-scale solar facilities

(the annual number of estimated bird deaths per megawatt of electrical capacity) is 2.7, and 9.9 for known and unknown fatalities (which include carcasses found on the project site of which the death is not known). McCrary *et al.* (1986) found an average rate of mortality of 1.9-2.2 birds per week affecting 0.6-0.7 % of the local bird population. However, most of the avian fatalities at these solar facilities are also probably underestimated since 10-30 % of dead birds are removed by scavengers before being noted.. From these analyses and assessments it was evident that:

- Medium levels of bird fatalities occur at PV sites when compared to CSP sites (when taking powerline collisions into account).
- Approximately 81 % of all avian mortalities were caused by collisions, including collisions with electrical distribution lines.
- Most of the mortalities were small passerines (especially swallows).
- Fatalities at these solar facilities also include waterbirds (e.g. grebes, herons and gulls) which were probably attracted by the apparent "lake effect" caused by the reflective surface of the PV panels.
- Approximately 10-11 % of the fatalities consists of waterbirds, but could be as high as 49 % at certain facilities.
- It is unclear if the "lake effect" caused by the panels (at PV facilities) or mirrors (at CSP facilities) are the main cause of birds colliding or interacting with the infrastructure (since both waterbirds and other passerines are colliding with the infrastructure).
- Most of the fatalities are of resident birds as opposed to migratory species.

In a review report by Harrison *et al.* (2016), an attempt was made to provide evidence of the impacts caused by solar PV facilities alone (not combined with CSP facilities) on birds in the UK. These authors reviewed approximately 420 scientific documents, including 37 so-called "grey" literature from non-government and government organisations for any evidence relating to the ecological impacts of solar PV facilities. Their main findings were as follows:

- The majority of the documents were not relevant and peer-reviewed documents of experimental scientific evidence on avian fatalities were non-existent.
- Results based on carcass searches suggest that the bird collision risk at PV developments are low, although these studies did not take collision by overhead power lines into account.
- Many of the documents recommended that PV developments in close proximity to protected areas should be avoided.
- The PV panels reflect polarised light, which can attract polarotactic insects with potential impact to their reproductive biology. In addition, the polarising effect of the PV panels may also induce drinking behaviour in some birds, which may mistake the panels for water.

They conclude that impact assessment reports should consider taxon-specific requirements of birds and their guilds.

3.10.2 Potential impacts of PV solar facilities on birds

The magnitude and significance of impacts to birds caused by solar facilities will depend on the following factors:

- The geographic locality of the planned solar facility;
- The size or surface extent of the solar facility;
- The type of solar facility (according to the technologies applied, e.g. PV or Concentrated Solar Power (CSP)); and
- The occurrence of collision-prone bird species (which are often closely related to the locality of the solar facility).

Any planned solar facility corresponding to an area with many threatened, range-restricted or collision-prone species will have a higher impact on these birds. In addition, any planned solar facility located in close proximity to important flyways, wetland systems or roosting/nesting sites used by the aforementioned species will have a higher impact.

The main impacts associated with PV solar facilities include (Jenkins *et al*., 2017):

- The loss of habitat and subsequent displacement of bird species due to the ecological footprint required during construction;
- Disturbances caused to birds during construction and operation;
- Direct interaction (collision trauma) by birds with the surface infrastructure (photovoltaic panels) caused by polarised light pollution and/or waterbirds colliding with the panels (as they are mistaken for waterbodies);
- Collision with associated infrastructure (mainly overhead powerlines and reticulation);
- Attracting novel species to the area (owing to the artificial provision of new habitat such as perches and shade) which could compete with the residing bird population.

3.11 Potential Impacts associated with the proposed PV Solar Facility

Table 3 provides a preliminary summary of the impacts anticipated and a preliminary quantification thereof.

3.11.1 Loss of habitat and displacement of birds

Approximately 72ha of the study site will cleared of vegetation and habitat to accommodate the panel arrays and associated infrastructure. Clearing of vegetation will inevitably result in the loss of habitat and displacement of bird species. From the preliminary results it is evident that smaller passerine species are more likely to become displaced as opposed to non-passerine species. It is particularly endemic

species that are likely to become displaced, as well as habitat specialists (e.g. grassland specialists) which will disappear from the area. Nevertheless, at least six pairs of Northern Black Korhaan (*Afrotis afraoides*) could occur on the study site and may become displaced.

To quantify the impact it is necessary to calculate the number of birds (density) lost or displaced by the activity, including estimated density values of important species per unit area of habitat. This will be conducted during a baseline survey of the proposed study area. +From a preliminary analysis, the following bird species are most likely to be impacted by the loss of habitat due to their habitat requirements, fecundity and conservation status (although not limited to) due to the proposed development:

- Cloud Cisticola (Cisticola textrix); and
- Northern Black Korhaan (*Afrotis afraoides*).

3.11.2 Collision trauma caused by photovoltaic panels (the "lake-effect")

The proximity of pans, inundated depressions and the large Stinkpan to the study site increases the risk of waterbirds and shorebird taxa interacting with the PV panels. A number of waterbird species are expected to occur with a high frequency of traversing the study site on a daily basis (bird dispersing between the water features) which could interact with the PV panels.

Appropriate application of bird deterrent devices are highly recommended, which may include a combination of rotating flashers/reflectors, including diverters which emit light during nigh time to increase the visibility of the infrastructure for birds such as flamingos which tend to disperse during the night. Post construction monitoring to quantify mortalities will be important during to early operational phase in order to determine "hotspot" areas which may require additional mitigation measures.

Desktop results and site observations show that the following species could interact with the panel infrastructure:

- South African Shelduck (*Tadorna cana*);
- Egyptian Goose (*Alopochen aegyptiaca*);
- Spur-winged Goose (*Plectropterus gambiensis*);
- Yellow-billed Duck (*Anas undulata*);
- White-faced Duck (*Dendrocygna viduata*);
- Red-billed Teal (*Anas erythrorhynchus*);
- Cape Teal (*Anas capensis*);
- Cape Shoveller (*Anas smithii*);
- Glossy Ibis (*Plegadis falcinellus*);
- Black-winged Stilt (*Himantopus himantopus*);
- Three-banded Plover (*Charadrius tricollaris*); and potentially also
- Greater Flamingo (*Phoenicopterus roseus*);

- Lesser Flamingo (*Phoeniconaias minor*);
- Maccoa Duck (*Oxyura maccoa*);
- White-breasted Cormorant (*Phalacrocorax lucidus*)
- Reed Cormorant (*Microcarbo africanus*);
- African Sacred Ibis (*Threskiornis aethiopicus*) and potentially also
- Little Grebe (*Tachybaptus ruficollis*);
- Black-headed Heron (*Ardea melanocephala*);
- Red-knobbed Coot (*Fulica cristata*);
- Grey Heron (*Ardea cinerea*);
- Little Egret (*Egretta garzetta*);
- Great Egret (*Ardea alba*);
- African Darter (*Anhinga rufa*);
- Common Moorhen (*Gallinula chloropus*) and
- African Swamphen (*Porphyrio madagascariensis*).

3.11.3 Interaction with overhead powerlines and reticulation

A 132kV overhead powerline is proposed to tie-in to the Avgold (6.6/44 kV) substation. Almost the entire corridor will traverse transformed land occupied by mining infrastructure. Birds are impacted in three ways by means of overhead powerlines (described below). It is however a common rule that large and heavy-bodied terrestrial bird species are more at risk of being affected in a negative way when interacting with powerlines in general. These include the following:

- *Electrocution*

Electrocution happens when a bird bridges the gap between the live components or a combination of a live and earth component of a power line, thereby creating a short circuit. This happens when a bird, mainly a species with a fairly large wingspan attempts to perch on a tower or attempts to fly-off a tower. Many of these species include vultures (of the genera *Gyps* and *Torgos*) as well as other large birds of prey such as the Martial Eagle (*Polemaetus bellicosus*) (Ledger & Annegarn, 1981; Kruger, 1999; Van Rooyen, 2000). These species will attempt to roost and even breed on the tower structures if available nesting platforms are a scarce commodity in the area. Other types of electrocutions happen by means of so-called “bird-streamers”. This happens when a bird, especially when taking off, excretes and thereby causes a short-circuit through the fluidity excreta (Van Rooyen & Taylor, 1999).

Large transmission lines (from 220 kV to 765 kV) are seldom a risk of electrocution, although smaller distribution lines (88 – 132kV) pose a higher risk. However, for this project, the design of the pylon is an important consideration in preventing bird electrocutions. The proposed pylon design should incorporate the following design parameters:

- The clearances between the live components should exceed the wingspan of any bird species;
- The height of the tower should allow for unrestricted movement of terrestrial birds between successive pylons;
- The live components should be "bundled" to increase the visibility for approaching birds;
- "Bird streamers" should be eliminated by discouraging birds from perching above the conductors.

It is therefore recommended that the pylon design incorporates "features as illustrated by Figure 12[7].

From Figure 12 it is clear that perching of birds is discouraged by the addition of diagonal crossbars or by doing away with the crossbars that holds the conductors in place. Bird "streamers" are also eliminated by fitting the poles with bird guards/spikes above the conductors. However, safe perching is facilitated by the fitment of a horizontal bar on top of the pole structure without the risk of electrocution (due to the perpendicular orientation of the bar relative to the conductors).

Figure 12: Two bird-friendly tower designs to be used for the current project.

- *Collision*

Collisions with earth wires have probably accounted for most bird-powerline interactions in South Africa. In general, the earth wires are much thinner in diameter when compared to the live components, and therefore less visible to approaching birds. Many of the species likely to be affected include heavy, large-bodied terrestrial species such as bustards, korhaans and a variety of waterbirds that are not very agile or manoeuvrable once airborne. These species, especially those with the habit of flying with outstretched necks (e.g. most species of storks) find it difficult to make a

[7] Please note that these are examples of recommended pylon designs. These are taken from steel monopole pylons.

sudden change in direction while flying – resulting in the bird flying into the earth wires.

Areas where bird collisions are likely to be high could be ameliorated by marking the lines with appropriate bird deterrent devices such as “bird diverters” and “flappers” (BFD) to increase the visibility of the lines. It is proposed that the overhead powerlines (including existing lines) considers the fitment of dynamic devices such as the "Viper live bird flapper" and nocturnal LED solar-charged bird diverters owing to the potential nocturnal flyovers by flamingo taxa (see Figure 13). Specific areas or spans where BFDs should be applied will be determined during the baseline/EIA survey.

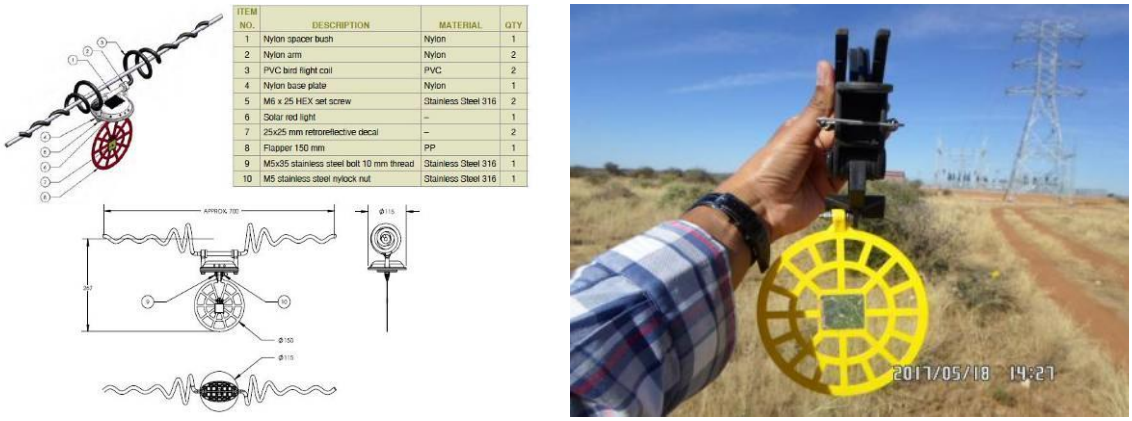

Figure 13: Examples of bird flight diverters to be fitted to the power lines: Nocturnal LED solar-charged bird diverter (left) and Viper live bird flapper (right).

- *Physical disturbances and habitat destruction caused during construction and maintenance*

It is anticipated that part of the powerline line servitude will be cleared of vegetation. In addition, construction activities go hand in hand with high ambient noise levels. Although construction is considered temporary, many species will vacate the area during the construction phase and will become temporarily displaced.

Table 3: A preliminary summery of impacts associated with the proposed PV facility and its infrastructure.

Issue 1	**Nature of Impact**	**Extent**	**No-Go Areas**
Impact: Losses of natural habitat and displacement of birds through physical transformation, modifications, removals and land clearance. This impact is mainly restricted to the construction phase and is permanent.			
Habitat destruction and disturbance and/or displacement of birds	Negative, especially for endemic species and terrestrial bird species.	Local	Pans and wetlands
Description of expected significance of impact: The impact will be of a long duration, (prior to mitigation). The impact is expected to have a low significance if the sensitivity map is considered due to the current poor ecological condition of most of the terrestrial habitat types			
Gaps in knowledge and recommendations for further study: A baseline survey to determine relative bird densities and distribution ranges.			

Issue 2	**Nature of Impact**	**Extent**	**No-Go Areas**
Impact: Avian collision impacts related to the PV facility during the operational phase (collision with the PV panels).			
Potential collision of waterbirds with the PV panel structures	Negative, especially for waterbirds and shorebird taxa	Local and immediate surrounding area	To be determined - pans and welands
Description of expected significance of impact: The impact will be of a long duration (prior to mitigation) and is probable with a high significance, but may be reduced to a medium significance according to placement of PV arrays and appropriate mitigation and monitoring protocols (to be assessed during the EIA phase).			
Gaps in knowledge and recommendations for further study: A survey is proposed to determine occurrence of waterbird species.			

Issue 3	**Nature of Impact**	**Extent**	**No-Go Areas**
Impact: Avian collision impacts related to the powerline reticulation and new distribution lines during operation.			
Potential collision due to electrical overhead distribution lines	Negative, especially for large-bodied species and potentially also storks and flamingo taxa	Site	N/a
Description of expected significance of impact: The impact will be of a long duration (prior to mitigation) and probable with a low significance since most of the proposed corridor traverses active mining infrastructure (transformed land). Any potential collisions may be reduced as per recommended mitigation measures (to be assessed during the EIA phase).			
Gaps in knowledge and recommendations for further study: A baseline survey is proposed to determine the occurrence of collision prone bird species.			

3.12 Collision-prone bird species

A total of 59 collision-prone bird species have been recorded from the study area, of which 46 species are waterbirds and seven species are birds of prey (Table 4). According to Table 4, it is evident that the number of collision-prone species that could occur on the study area is high (c. 45% of the total number of bird species recorded in the area).

Table 4: Collision-prone bird species and Red listed species (in red) expected to be present on the study site and immediate surroundings inferred from the South African Atlas Project (SABAP2).

Common Name	Scientific Name	SABAP2 Reporting Rate			
		Full Protocol (%)	Number of cards	Ad Hoc Protocol (%)	Number of cards
African Darter	*Anhinga rufa*	16.67	1	0.00	0
African Fish Eagle	*Haliaeetus vocifer*	16.67	1	0.00	0
African Marsh Harrier	*Circus ranivorus*	16.67	1	0.00	0
African Sacred Ibis	*Threskiornis aethiopicus*	16.67	1	0.00	0
African Spoonbill	*Platalea alba*	50.00	3	0.00	0
African Swamphen	*Porphyrio madagascariensis*	16.67	1	0.00	0
Amur Falcon	*Falco amurensis*	16.67	1	0.00	0
Black Heron	*Egretta ardesiaca*	16.67	1	0.00	0
Black-crowned Night Heron	*Nycticorax nycticorax*	16.67	1	0.00	0
Black-headed Heron	*Ardea melanocephala*	66.67	4	0.00	0
Black-necked Grebe	*Podiceps nigricollis*	33.33	2	12.50	1
Black-winged Kite	*Elanus caeruleus*	50.00	3	0.00	0
Black-winged Stilt	*Himantopus himantopus*	66.67	4	37.50	3
Blue-billed Teal	*Spatula hottentota*	33.33	2	0.00	0
Cape Shoveler	*Spatula smithii*	33.33	2	0.00	0
Cape Teal	*Anas capensis*	33.33	2	12.50	1
Common Buzzard	*Buteo buteo*	33.33	2	0.00	0
Common Moorhen	*Gallinula chloropus*	33.33	2	0.00	0
Common Sandpiper	*Actitis hypoleucos*	16.67	1	12.50	1
Egyptian Goose	*Alopochen aegyptiaca*	50.00	3	0.00	0
Glossy Ibis	*Plegadis falcinellus*	83.33	5	12.50	1
Goliath Heron	*Ardea goliath*	33.33	2	0.00	0
Great Crested Grebe	*Podiceps cristatus*	0.00	0	12.50	1
Great Egret	*Ardea alba*	33.33	2	0.00	0
Greater Flamingo	*Phoenicopterus roseus*	83.33	5	62.50	5
Grey Heron	*Ardea cinerea*	33.33	2	0.00	0
Grey-headed Gull	*Chroicocephalus cirrocephalus*	83.33	5	12.50	1
Hadada Ibis	*Bostrychia hagedash*	50.00	3	0.00	0
Helmeted Guineafowl	*Numida meleagris*	83.33	5	0.00	0

Common Name	Scientific Name	SABAP2 Reporting Rate			
		Full Protocol (%)	Number of cards	Ad Hoc Protocol (%)	Number of cards
Lesser Flamingo	*Phoeniconaias minor*	66.67	4	50.00	4
Lesser Kestrel	*Falco naumanni*	16.67	1	12.50	1
Little Bittern	*Ixobrychus minutus*	16.67	1	0.00	0
Little Egret	*Egretta garzetta*	16.67	1	0.00	0
Little Grebe	*Tachybaptus ruficollis*	66.67	4	0.00	0
Little Stint	*Calidris minuta*	16.67	1	12.50	1
Maccoa Duck	*Oxyura maccoa*	16.67	1	0.00	0
Marsh Sandpiper	*Tringa stagnatilis*	16.67	1	0.00	0
Northern Black Korhaan	*Afrotis afraoides*	50.00	3	0.00	0
Pied Crow	*Corvus albus*	16.67	1	0.00	0
Purple Heron	*Ardea purpurea*	16.67	1	0.00	0
Red-billed Teal	*Anas erythrorhyncha*	50.00	3	0.00	0
Red-knobbed Coot	*Fulica cristata*	83.33	5	25.00	2
Reed Cormorant	*Microcarbo africanus*	33.33	2	0.00	0
Rock Kestrel	*Falco rupicolus*	16.67	1	0.00	0
Ruff	*Calidris pugnax*	16.67	1	12.50	1
South African Shelduck	*Tadorna cana*	16.67	1	0.00	0
Southern Pochard	*Netta erythrophthalma*	16.67	1	0.00	0
Speckled Pigeon	*Columba guinea*	100.00	6	12.50	1
Spur-winged Goose	*Plectropterus gambensis*	50.00	3	0.00	0
Squacco Heron	*Ardeola ralloides*	16.67	1	0.00	0
Swainson's Spurfowl	*Pternistis swainsonii*	33.33	2	0.00	0
Three-banded Plover	*Charadrius tricollaris*	50.00	3	0.00	0
Western Cattle Egret	*Bubulcus ibis*	83.33	5	12.50	1
Whiskered Tern	*Chlidonias hybrida*	16.67	1	0.00	0
White-breasted Cormorant	*Phalacrocorax lucidus*	16.67	1	0.00	0
White-faced Whistling Duck	*Dendrocygna viduata*	33.33	2	0.00	0
White-winged Tern	*Chlidonias leucopterus*	16.67	1	0.00	0
Yellow-billed Duck	*Anas undulata*	83.33	5	0.00	0
Yellow-billed Stork	*Mycteria ibis*	16.67	1	0.00	0

4. PLAN OF STUDY FOR THE EIA PHASE

Due to the limited level of detail that is normally implemented during a scoping assessment, it is imperative that detailed avifaunal investigations be conducted on the study area at an appropriate season.

4.1 Proposed approach and methods

The following methods are proposed during an austral summer season survey:

- Active searching and the compilation of a bird inventory while traversing much of the available habitat types;
- The determination of the occurrence of Red Data species and collision-prone bird species;
- The identification and mapping of suitable habitat for species of conservation concern while focussing on structural and topographical cues;
- A landscape analysis of important flyways or daily flight paths corresponding to important landscape features; and
- Density estimates will be collected by means of point counts to evaluate the dominant/typical species and their respective relative densities at each site. At each point the number of bird species seen will be recorded, as well as their respective abundances and distance from the observer (by means of a rangefinder). The data generated from the point counts will be analysed according to Clarke & Warwick (1994) based on the computed percentage contribution (%) of each species including the consistency (calculated as the similarity coefficient/standard deviation) of its contribution to the each habitat type.
- Suitable bird repelling structures and bird diverters will be provided to avoid collision of birds with the PV facility and associated powerlines.

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Appendix 1: A shortlist of bird species recorded on the study area. The list provides an indication of the species occurrence according to SABAP2 reporting rates.

#	Common Name	Scientific Name	SABAP2 Reporting Rate			
			Full Protocol (%)	Number of cards	Ad Hoc Protocol (%)	Number of cards
432	Acacia Pied Barbet	*Tricholaema leucomelas*	66.67	4	0.00	0
52	African Darter	*Anhinga rufa*	16.67	1	0.00	0
149	African Fish Eagle	*Haliaeetus vocifer*	16.67	1	0.00	0
418	African Hoopoe	*Upupa africana*	50.00	3	12.50	1
167	African Marsh Harrier	*Circus ranivorus*	16.67	1	0.00	0
387	African Palm Swift	*Cypsiurus parvus*	0.00	0	12.50	1
692	African Pipit	*Anthus cinnamomeus*	50.00	3	0.00	0
544	African Red-eyed Bulbul	*Pycnonotus nigricans*	33.33	2	0.00	0
81	African Sacred Ibis	*Threskiornis aethiopicus*	16.67	1	0.00	0
85	African Spoonbill	*Platalea alba*	50.00	3	0.00	0
576	African Stonechat	*Saxicola torquatus*	66.67	4	0.00	0
208	African Swamphen	*Porphyrio madagascariensis*	16.67	1	0.00	0
119	Amur Falcon	*Falco amurensis*	16.67	1	0.00	0
575	Ant-eating Chat	*Myrmecocichla formicivora*	83.33	5	0.00	0
493	Barn Swallow	*Hirundo rustica*	16.67	1	0.00	0
64	Black Heron	*Egretta ardesiaca*	16.67	1	0.00	0
650	Black-chested Prinia	*Prinia flavicans*	83.33	5	12.50	1
69	Black-crowned Night Heron	*Nycticorax nycticorax*	16.67	1	0.00	0
55	Black-headed Heron	*Ardea melanocephala*	66.67	4	0.00	0
5	Black-necked Grebe	*Podiceps nigricollis*	33.33	2	12.50	1
245	Blacksmith Lapwing	*Vanellus armatus*	100.00	6	12.50	1

#	Common Name	Scientific Name	SABAP2 Reporting Rate			
			Full Protocol (%)	Number of cards	Ad Hoc Protocol (%)	Number of cards
860	Black-throated Canary	*Crithagra atrogularis*	33.33	2	12.50	1
130	Black-winged Kite	*Elanus caeruleus*	50.00	3	0.00	0
270	Black-winged Stilt	*Himantopus himantopus*	66.67	4	37.50	3
839	Blue Waxbill	*Uraeginthus angolensis*	16.67	1	0.00	0
99	Blue-billed Teal	*Spatula hottentota*	33.33	2	0.00	0
714	Brown-crowned Tchagra	*Tchagra australis*	16.67	1	0.00	0
703	Cape Longclaw	*Macronyx capensis*	50.00	3	0.00	0
94	Cape Shoveler	*Spatula smithii*	33.33	2	0.00	0
786	Cape Sparrow	*Passer melanurus*	100.00	6	12.50	1
737	Cape Starling	*Lamprotornis nitens*	33.33	2	0.00	0
98	Cape Teal	*Anas capensis*	33.33	2	12.50	1
316	Ring-necked Dove	*Streptopelia capicola*	100.00	6	12.50	1
686	Cape Wagtail	*Motacilla capensis*	50.00	3	0.00	0
484	Chestnut-backed Sparrow-Lark	*Eremopterix leucotis*	16.67	1	0.00	0
658	Chestnut-vented Warbler	*Curruca subcoerulea*	33.33	2	0.00	0
631	Cloud Cisticola	*Cisticola textrix*	16.67	1	0.00	0
154	Common Buzzard	*Buteo buteo*	33.33	2	0.00	0
210	Common Moorhen	*Gallinula chloropus*	33.33	2	0.00	0
734	Common Myna	*Acridotheres tristis*	100.00	6	0.00	0
258	Common Sandpiper	*Actitis hypoleucos*	16.67	1	12.50	1
439	Crested Barbet	*Trachyphonus vaillantii*	50.00	3	12.50	1
242	Crowned Lapwing	*Vanellus coronatus*	100.00	6	0.00	0
630	Desert Cisticola	*Cisticola aridulus*	50.00	3	0.00	0
352	Diederik Cuckoo	*Chrysococcyx caprius*	16.67	1	0.00	0

#	Common Name	Scientific Name	SABAP2 Reporting Rate			
			Full Protocol (%)	Number of cards	Ad Hoc Protocol (%)	Number of cards
	Double-banded Courser	*Rhinoptilus africanus*	n/a			
849	Dusky Indigobird	*Vidua funerea*	16.67	1	0.00	0
66	Dwarf Bittern	*Ixobrychus sturmii*	16.67	1	0.00	0
89	Egyptian Goose	*Alopochen aegyptiaca*	50.00	3	0.00	0
404	European Bee-eater	*Merops apiaster*	16.67	1	12.50	1
570	Familiar Chat	*Oenanthe familiaris*	33.33	2	0.00	0
665	Fiscal Flycatcher	*Melaenornis silens*	33.33	2	0.00	0
83	Glossy Ibis	*Plegadis falcinellus*	83.33	5	12.50	1
56	Goliath Heron	*Ardea goliath*	33.33	2	0.00	0
4	Great Crested Grebe	*Podiceps cristatus*	0.00	0	12.50	1
58	Great Egret	*Ardea alba*	33.33	2	0.00	0
86	Greater Flamingo	*Phoenicopterus roseus*	83.33	5	62.50	5
502	Greater Striped Swallow	*Cecropis cucullata*	66.67	4	12.50	1
419	Green Wood Hoopoe	*Phoeniculus purpureus*	33.33	2	0.00	0
54	Grey Heron	*Ardea cinerea*	33.33	2	0.00	0
288	Grey-headed Gull	*Chroicocephalus cirrocephalus*	83.33	5	12.50	1
84	Hadada Ibis	*Bostrychia hagedash*	50.00	3	0.00	0
192	Helmeted Guineafowl	*Numida meleagris*	83.33	5	0.00	0
784	House Sparrow	*Passer domesticus*	83.33	5	12.50	1
1104	Karoo Thrush	*Turdus smithi*	50.00	3	0.00	0
317	Laughing Dove	*Spilopelia senegalensis*	100.00	6	12.50	1
87	Lesser Flamingo	*Phoeniconaias minor*	66.67	4	50.00	4
125	Lesser Kestrel	*Falco naumanni*	16.67	1	12.50	1
604	Lesser Swamp Warbler	*Acrocephalus gracilirostris*	16.67	1	0.00	0

#	Common Name	Scientific Name	SABAP2 Reporting Rate			
			Full Protocol (%)	Number of cards	Ad Hoc Protocol (%)	Number of cards
646	Levaillant's Cisticola	*Cisticola tinniens*	83.33	5	0.00	0
67	Little Bittern	*Ixobrychus minutus*	16.67	1	0.00	0
59	Little Egret	*Egretta garzetta*	16.67	1	0.00	0
6	Little Grebe	*Tachybaptus ruficollis*	66.67	4	0.00	0
253	Little Stint	*Calidris minuta*	16.67	1	12.50	1
385	Little Swift	*Apus affinis*	16.67	1	12.50	1
818	Long-tailed Widowbird	*Euplectes progne*	66.67	4	0.00	0
103	Maccoa Duck	*Oxyura maccoa*	16.67	1	0.00	0
397	Malachite Kingfisher	*Corythornis cristatus*	16.67	1	0.00	0
262	Marsh Sandpiper	*Tringa stagnatilis*	16.67	1	0.00	0
564	Mountain Wheatear	*Myrmecocichla monticola*	16.67	1	0.00	0
318	Namaqua Dove	*Oena capensis*	50.00	3	0.00	0
637	Neddicky	*Cisticola fulvicapilla*	33.33	2	0.00	0
1035	Northern Black Korhaan	*Afrotis afraoides*	50.00	3	0.00	0
1171	Orange River White-eye	*Zosterops pallidus*	50.00	3	0.00	0
522	Pied Crow	*Corvus albus*	16.67	1	0.00	0
746	Pied Starling	*Lamprotornis bicolor*	50.00	3	0.00	0
846	Pin-tailed Whydah	*Vidua macroura*	16.67	1	0.00	0
57	Purple Heron	*Ardea purpurea*	16.67	1	0.00	0
844	Quailfinch	*Ortygospiza atricollis*	83.33	5	0.00	0
642	Rattling Cisticola	*Cisticola chiniana*	33.33	2	0.00	0
805	Red-billed Quelea	*Quelea quelea*	66.67	4	0.00	0
97	Red-billed Teal	*Anas erythrorhyncha*	50.00	3	0.00	0
488	Red-capped Lark	*Calandrella cinerea*	66.67	4	0.00	0

#	Common Name	Scientific Name	SABAP2 Reporting Rate			
			Full Protocol (%)	Number of cards	Ad Hoc Protocol (%)	Number of cards
314	Red-eyed Dove	*Streptopelia semitorquata*	66.67	4	0.00	0
392	Red-faced Mousebird	*Urocolius indicus*	50.00	3	0.00	0
212	Red-knobbed Coot	*Fulica cristata*	83.33	5	25.00	2
50	Reed Cormorant	*Microcarbo africanus*	33.33	2	0.00	0
940	Rock Dove	*Columba livia*	33.33	2	12.50	1
123	Rock Kestrel	*Falco rupicolus*	16.67	1	0.00	0
256	Ruff	*Calidris pugnax*	16.67	1	12.50	1
619	Rufous-eared Warbler	*Malcorus pectoralis*	0.00	0	12.50	1
458	Rufous-naped Lark	*Mirafra africana*	50.00	3	0.00	0
90	South African Shelduck	*Tadorna cana*	16.67	1	0.00	0
707	Southern Fiscal	*Lanius collaris*	83.33	5	0.00	0
4142	Southern Grey-headed Sparrow	*Passer diffusus*	16.67	1	0.00	0
803	Southern Masked Weaver	*Ploceus velatus*	83.33	5	25.00	2
102	Southern Pochard	*Netta erythrophthalma*	16.67	1	0.00	0
808	Southern Red Bishop	*Euplectes orix*	100.00	6	12.50	1
311	Speckled Pigeon	*Columba guinea*	100.00	6	12.50	1
474	Spike-heeled Lark	*Chersomanes albofasciata*	66.67	4	0.00	0
654	Spotted Flycatcher	*Muscicapa striata*	16.67	1	0.00	0
88	Spur-winged Goose	*Plectropterus gambensis*	50.00	3	0.00	0
62	Squacco Heron	*Ardeola ralloides*	16.67	1	0.00	0
185	Swainson's Spurfowl	*Pternistis swainsonii*	33.33	2	0.00	0
238	Three-banded Plover	*Charadrius tricollaris*	50.00	3	0.00	0
851	Village Indigobird	*Vidua chalybeata*	16.67	1	0.00	0
735	Wattled Starling	*Creatophora cinerea*	50.00	3	0.00	0

#	Common Name	Scientific Name	SABAP2 Reporting Rate			
			Full Protocol (%)	Number of cards	Ad Hoc Protocol (%)	Number of cards
61	Western Cattle Egret	*Bubulcus ibis*	83.33	5	12.50	1
305	Whiskered Tern	*Chlidonias hybrida*	16.67	1	0.00	0
47	White-breasted Cormorant	*Phalacrocorax lucidus*	16.67	1	0.00	0
780	White-browed Sparrow-Weaver	*Plocepasser mahali*	100.00	6	25.00	2
100	White-faced Whistling Duck	*Dendrocygna viduata*	33.33	2	0.00	0
383	White-rumped Swift	*Apus caffer*	16.67	1	25.00	2
495	White-throated Swallow	*Hirundo albigularis*	83.33	5	0.00	0
304	White-winged Tern	*Chlidonias leucopterus*	16.67	1	0.00	0
866	Yellow Canary	*Crithagra flaviventris*	33.33	2	0.00	0
96	Yellow-billed Duck	*Anas undulata*	83.33	5	0.00	0
76	Yellow-billed Stork	*Mycteria ibis*	16.67	1	0.00	0
812	Yellow-crowned Bishop	*Euplectes afer*	33.33	2	0.00	0
629	Zitting Cisticola	*Cisticola juncidis*	33.33	2	0.00	0